

# Physicochemical foundations of glass

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Lecture: Tuesdays 14:00 - 16:00 Location: Hörsaal Fraunhoferstr. 6

First lecture: April 9 2024

Exercises: Thursdays 10:00 - 12:00 Location: Fürstengraben 1, SR 166

First Exercise: April 11 2024

The exercises will be held in the form of a proseminar, i.e. the participants give seminar talks to a specific theme.

## Structure of the lecture course

### 1. Overview

### 2. Materials

- 2.1 Silicates and Borates
- 2.2 Polymers
- 2.3 Organic Semiconductors

### 3. Preparation

- 3.1 Quenching from the melt
- 3.2 Deposition onto substrates

### 4. Structure

- 4.1 Liquid structure and molecular distribution
- 4.2 Gelation and Network models

### 5. Viscosity and glass transition

- 5.1 Maxwell viscoelasticity
- 5.2 Glass transition as very-slow relaxation limit
- 5.3 Thermal properties and Kauzmann paradox

### 6. Theories and models for the glass transition

- 6.1 Adam-Gibbs model
- 6.2 Mode-coupling theory
- 6.3 Spin glasses and Potts models
- 6.4 Dynamical facilitation
- 6.5 Replica theory

### 7. Atomic, ionic and electronic transport in amorphous materials

- 7.1 Phenomenology: Jonscher  $\omega^s$  law for the AC conductivity
- 7.2 Coherent-potential approximation

### 8. Vibrational excitations in glasses

- 8.1 Experimental methods, boson peak
- 8.2 Various models for the boson peak
- 8.3 Mathematical analogy between AC conductivity and anomalous vibrations
- 8.4 Heterogeneous-elasticity theory
- 8.5 Theory of low-frequency Raman scattering